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Claims

[c1] 1. A process of depositing a ceramic coating on a surface, the process comprising the steps of:
using at least one evaporation source to provide multiple different oxide compounds and at least one carbide compound comprising carbon and an element; and
evaporating the at least one evaporation source to produce a vapor cloud that contacts and condenses on the surface to form the ceramic coating, the ceramic coating comprising the oxide compounds, an oxide of the element of the carbide compound, and at least one of elemental carbon, a carbon-containing gas, and precipitates of the carbide compound.

[c2] 2. A process according to claim 1, wherein the oxide of the element has a vapor pressure that is at least an order of magnitude different than the vapor pressure of at least one of the oxide compounds.

[c3] 3. A process according to claim 1, wherein the carbide compound is at least one of YbC_2, NdC_2, and LaC_2, whereby the oxide of the element is at least one of Yb_2O_3, Nd_2O_3, and La_2O3.

[c4] 4. A process according to claim 1, wherein the oxide compounds are yttria and zirconia and are present in the evaporation source as yttria-stabilized zirconia.

[c5] 5. A process according to claim 4, wherein the carbide compound has a vapor pressure within one order of magnitude of the vapor pressure of zirconia.

[c6] 6. A process according to claim 1, wherein the at least one evaporation source comprises two evaporation sources, the oxide compounds are present within a first of the evaporation sources, and the at least one carbide compound is present within a second of the evaporation sources.

[c7] 7. A process according to claim 6, wherein the first evaporation source consists of the oxide compounds and the second evaporation source consists of the at least one carbide compound.

[c8] 8. A process according to claim 1, wherein the at least one evaporation source consists of a single evaporation source, and the oxide compounds and the at least one carbide compound are present within the single evaporation source.

[c9] 9. A process according to claim 1, wherein the ceramic coating consists of the oxide compounds, the oxide of

the element of the carbide compound, and at least one of the carbide compound and the carbon-containing gas.

[c10] 10. A process according to claim 1, wherein the vapor cloud initially condenses on the surface so that the carbide compound is present in the ceramic coating, and the carbide compound is then reacted in situ to form the oxide of the element of the carbide compound and the carbon-containing gas.

[c11] 11. A process according to claim 1, wherein the carbon-containing gas is chosen from the group consisting of carbon dioxide and carbon monoxide.

[c12] 12. A process of depositing a thermal barrier coating on a surface of a gas turbine engine component, the process comprising the steps of:
placing the component in a coating chamber containing at least one ingot that provides zirconia, yttria, and at least one carbide compound chosen from the group consisting of YbC_2, NdC_2, and LaC_2;
projecting a high-energy beam on the at least one ingot to melt and form a vapor cloud; and
allowing the vapor cloud to contact and condense on the component to form the ceramic coating, the ceramic coating comprising yttria-stabilized zirconia, at least one oxide formed by oxidation of ytterbia, neodymia, and/or

lanthanum present as a result of dissociation of the at least one carbide compound, and a uniform distribution of at least one of elemental carbon and CO.

[c13] 13. A process according to claim 12, wherein yttria and zirconia are present in the at least one ingot as yttria-stabilized zirconia.

[c14] 14. A process according to claim 13, wherein the at least one carbide compound has a vapor pressure within one order of magnitude of the vapor pressure of zirconia.

[c15] 15. A process according to claim 12, wherein the at least one ingot comprises two ingots, yttria and zirconia are present within a first of the ingots, and the at least one carbide compound is present within a second of the ingots.

[c16] 16. A process according to claim 15, wherein the first ingot consists of yttria-stabilized zirconia and the second ingot consists of the at least one carbide compound.

[c17] 17. A process according to claim 12, wherein the at least one ingot consists of a single ingot that consists essentially of zirconia, yttria, and the at least one carbide compound.

[c18] 18. A process according to claim 12, wherein the ceramic

coating consists of yttria-stabilized zirconia, one of Yb_2O_3, Nd_2O_3, and La_2O_3, and at least one of CO and CO_2.

[c19] 19. A process according to claim 12, wherein the vapor cloud initially condenses on the component so that the at least one carbide compound is present in the ceramic coating, and the at least one carbide compound is then reacted in situ to form the at least one oxide and at least one of the elemental carbon and CO.

[c20] 20. A process according to claim 12, wherein the thermal barrier coating has a microstructure of columnar grains.

[c21] 21. An apparatus for depositing a ceramic coating on a surface, the apparatus comprising:
a coating chamber;
at least one evaporation source that provides multiple different oxide compounds and at least one carbide compound chosen from the group consisting of YbC_2, NdC_2, and LaC_2; and
means for evaporating the at least one evaporation source to produce a vapor cloud that contacts and condenses on the surface to form the ceramic coating.

[c22] 22. An apparatus according to claim 21, wherein the oxide compounds are yttria and zirconia and are present in the at least one evaporation source as yttria-stabilized

zirconia.

[c23] 23. An apparatus according to claim 22, wherein the at least one carbide compound has a vapor pressure within one order of magnitude of the vapor pressure of zirconia.

[c24] 24. An apparatus according to claim 21, wherein the at least one evaporation source comprises two evaporation sources, the oxide compounds are present within a first of the evaporation sources, and the at least one carbide compound is present within a second of the evaporation sources.

[c25] 25. An apparatus according to claim 24, wherein the first evaporation source consists of the oxide compounds and the second evaporation source consists of the at least one carbide compound.

[c26] 26. An apparatus according to claim 21, wherein the at least one evaporation source consists of a single evaporation source, and the oxide compounds and the at least one carbide compound are present within the single evaporation source.

[c27] 27. An electron-beam physical vapor deposition apparatus for depositing a ceramic coating on a component, the apparatus comprising:

a coating chamber in which the component is suspended;

at least one ingot that provides zirconia, yttria, and at least one carbide compound as evaporation sources within the coating chamber, the at least one carbide compound being chosen from the group consisting of YbC_2, NdC_2, and LaC_2; and

a high-energy beam projected on the at least one ingot; and

a vapor cloud within the coating chamber as a result of evaporation of the at least one ingot by the high-energy beam, the vapor cloud contacting and condensing on the component to form the ceramic coating, the ceramic coating comprising yttria-stabilized zirconia, at least one oxide formed by oxidation of ytterbia, neodymia and/or lanthanum present as a result of dissociation of the at least one carbide compound, and a uniform distribution of at least one of elemental carbon and CO.

[c28] 28. An apparatus according to claim 27, wherein yttria and zirconia are present in the at least one evaporation source as yttria-stabilized zirconia.

[c29] 29. An apparatus according to claim 27, wherein the carbide compound has a vapor pressure within one order of magnitude of the vapor pressure of zirconia.

[c30] 30. An apparatus according to claim 27, wherein the at least one ingot comprises two ingots, yttria and zirconia are present within a first of the ingots, and the at least one carbide compound is present within a second of the ingots.

[c31] 31. An apparatus according to claim 30, wherein the first ingot consists of yttria and zirconia and the second ingot consists of the at least one carbide compound.

[c32] 32. An apparatus according to claim 27, wherein the at least one ingot consists of a single ingot, and yttria, zirconia and the at least one carbide compound are present within the single ingot.